JUNE - 1961

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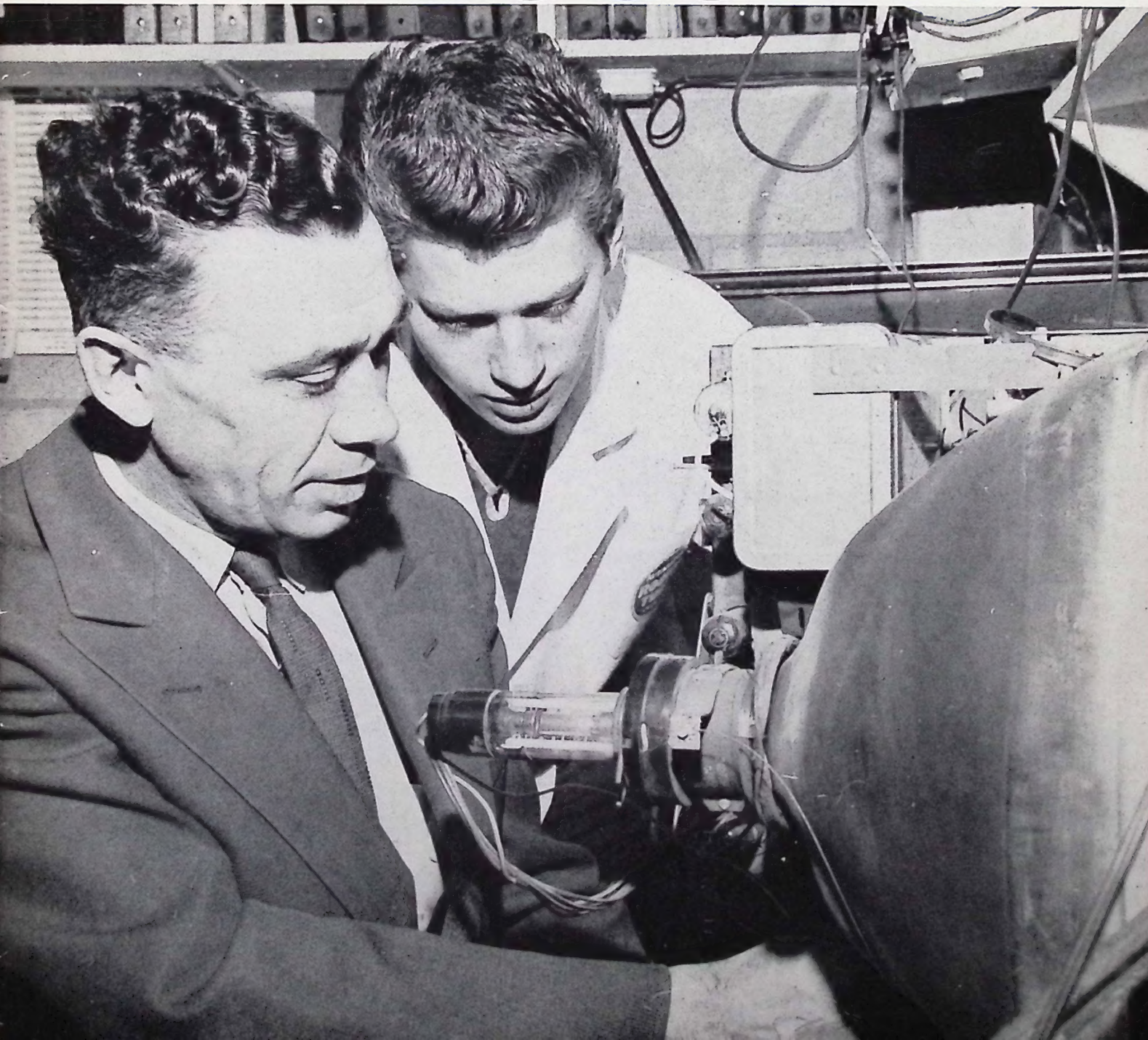
A MAGAZINE DEVOTED TO THE INTERESTS OF RADIO, HI-FI AND TV TECHNICIANS IN CANADA

ROGERS BOOSTER



cover story

Twenty-five dollars doesn't go far today — but back in 1945, Alf J. Reimer, of Steinbach, Manitoba opened a small radio repair shop with only twenty-five dollars worth of equipment.

Today, Alf's Radio and Electric serves one of the largest areas in Canada — twenty-five hundred square miles in south eastern Manitoba. Often service calls are 50 to 100 miles away.

Alf who believes, "best advertising is quality workmanship and prompt service", employs a staff of six men. His business consists of a large retail store and service shop on Main Street in Steinbach. The front part of the building has two separate sales areas for appliances and radio, hi-fi and television. At the rear of the building he maintains his service area and parts storage.

Part of his success lies in the organization of his service area. Alf believes in "having a place for everything and everything in its proper place". He maintains a large variety of stock. To cope with his ever increasing supply of tubes he has built racks to accommodate the some 450 different types in quantities of from one to five.

The shelves are made of 1-inch pine with masonite dividers. Other pine shelves house slide-drawer cabinets containing resistors and condensers, etc. Rows of corrugated stock bin-boxes store other service parts. The bin-boxes are in 2, 4, and 6-inch widths and include a simple and efficient stock control system with a price and supply record printed right on the box.

For efficiency of tool storage walls above work benches are covered in peg board. Each tool is outlined so that it can be quickly returned to its right position.

Alf believes the secret of servicing is to use a system in diagnosing: check tubes, make complete voltage check in a regular order. This system should usually provide the answer to the trouble in five minutes, he says.

Married and with five children ranging in age from 4 to 17, Alf Reimer is another Canadian who has seen a small radio repair shop grow into a prosperous, secure business.

technical section

The Thyratron in Industrial Electronics

In our last issue we discussed the ignitron and, in the typical circuit shown in that article, thyratrons were used for control. The thyratron being a smaller tube, it was assumed that the reader at least knew of its existence and its general application. Nevertheless we are going to describe it now in somewhat greater detail because so many of them are used in the industrial field.

This tube is a gaseous diode with the addition of a control grid. This sounds very much like an ordinary triode but the addition of gas or vapor greatly alters the characteristics and operation. The gas makes the tube quite useless as a grid-controlled amplifier and, instead, a valuable grid-controlled arc rectifier results. To serve its intended purpose, the grid must be an enclosure to control all passage of electrons and positive ions between cathode and anode. The grid may surround the cathode or enclose and separate both the anode and cathode. Passage through the grid may be through a wire mesh or by way of a single hole in a baffle.

The theory of operation of the thyratron can be explained by the use of the simple circuit shown in Figure 2. To start with, the filament (cathode) is heated to a temperature suitable for emission and switches S_P and S_C are open. Now S_P is closed so that a high positive potential is placed on the anode. With the grid isolated, nothing will happen provided the grid has a fine mesh. This is so because the isolated grid is made negative by electrons from the cathode landing on it, repelling other electrons emitted by the cathode so that few get by the grid to start ionization.

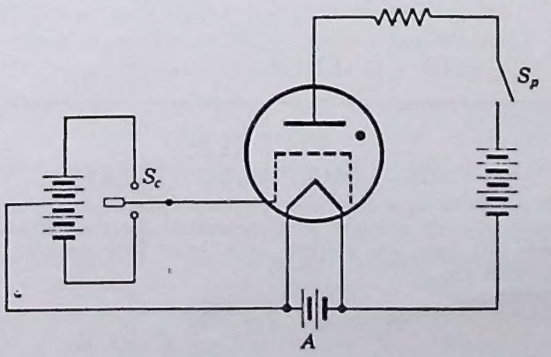


Fig. 2

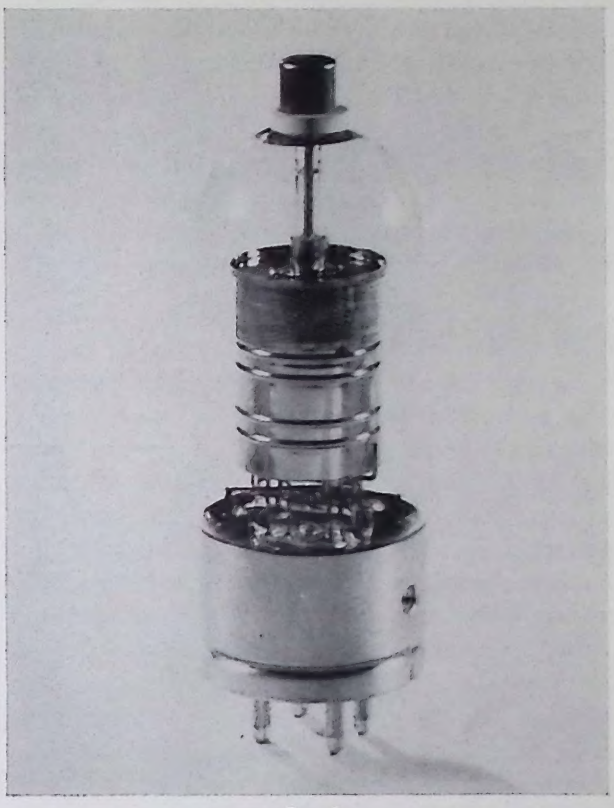


Fig. 1

Let us now close switch S_C to the positive side of the battery. Electrons will now pass easily through the grid, ionization will begin, an arc will develop and the tube will conduct, the magnitude of the current flow depending upon the resistance of the load. Once ionization has started, opening switch S_C to isolate the grid will have no effect upon the current flow. Even throwing the switch to the other side to make the grid negative will have no appreciable effect. So we see that, once the arc has started, the grid has no power to control or stop the current flow.

The reason for this loss of control by the grid lies in the presence of the positive ions in the arc. These ions constitute the "plasma". When the grid is negative, it attracts some of the positive ions and these cluster around the grid like a swarm of bees. Each positive ion captures an electron and becomes a neutral atom but the process is continuous and this sheath of positive ions creates a positive field or space charge for that particular region. Making the grid more negative only increases the thickness of the sheath (the spaces between anode and plasma

and cathode and plasma) and has no effect on the arc if the grid has a coarse mesh. However, if the mesh is very fine, the sheath will act to limit the cathode-anode arc. It is quite possible for a fine grid mesh and a high negative grid potential to limit or stop the arc but such means are not employed in practice. The simplest way to interrupt the arc when using direct current is to open the switch S_P. Interruption will also occur if the anode-cathode voltage is reduced below the ionizing potential.

Several factors determine the grid potential that will cause the arc to start and these are the size of the openings in the grid, the gas or vapor pressure, the shape and dimensions of the tube, the grid current and circuit resistance and the potential on the anode. One of the most important factors is the structure of the grid because, with a fine mesh grid, a positive potential must be applied to start conduction; whereas, with a coarse grid, it may start with a negative potential on the grid. Low gas pressures require a higher potential to start the arc. The potential on the anode determines the pull exerted upon the electrons so that high initial positive voltage on the anode will require a greater negative potential on the grid to prevent the formation of an arc. For a given tube, there is a certain ratio of anode-to-grid volts at which the tube will fire and this is called the grid control ratio.

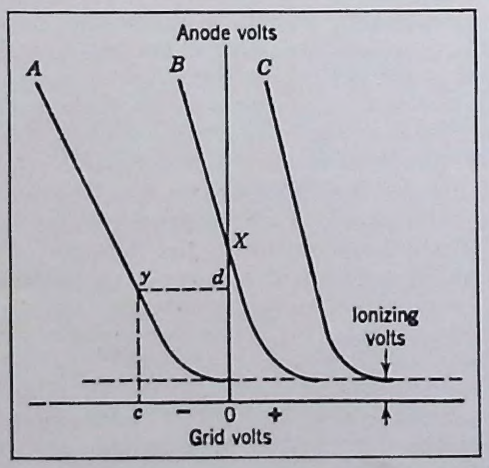


Fig. 3

The characteristics of thyratrons from which the grid control ratio is obtained are shown in Figure 3. For example, the grid control ratio for a tube having the characteristic A is cy/dy at point y. For other values of anode volts, horizontal lines may be extended to the curve A and then vertically downward to the grid volts line.

Thyratrons may be classified according to the polarity of the grid control voltage that permits conduction to start. A negative control tube is shown by curve A of Figure 3 where the grid must be negative for any value of anode potential to prevent the tube starting. Curve C is for a tube having a positive control and curve B is for a tube of the intermediate control class. The latter requires a positive grid for starting for anode voltages up to the point X and a negative grid for higher values. This tube has a short deionizing time and it is used in what are called inverter circuits.

One very obvious application of the thyratron is in a-c circuits. If the grid is made sufficiently positive so that conduction occurs for all values of anode voltage above the ionizing potential, an alternating current will be rectified exactly as it is by a gaseous diode. In addition to this, if the grid potential is suitably controlled, the tube may be made to conduct or supply current flow at will. If the grid is brought to the critical value (as determined by the grid control ratio), it will fire each time the anode potential becomes positive but, if the grid is made more negative, the current will cease at the end of the positive anode voltage loop. But, when the anode voltage becomes positive again on the next succeeding cycles, the tube will fail to fire.

This action of the grid in starting and stopping current rectification in the anode circuit has lead to the thyratron being referred to as a trigger tube.

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$5 FREE!

Typical Mobile Equipment

In our last issue we discussed mobile communications equipment in general and its application in cars and boats. We should now consider a specific piece of equipment and design features that are currently being used. For this example we have chosen the Rogers Majestic Mobilophone, the external appearance of which is shown in Figure 1 and a typical installation in Figure 2.

To understand its general design we will require a circuit diagram and, because of its size, this is provided as a folded insert with this issue of the Booster. The reader should preserve this insert because we will have to refer to it again.

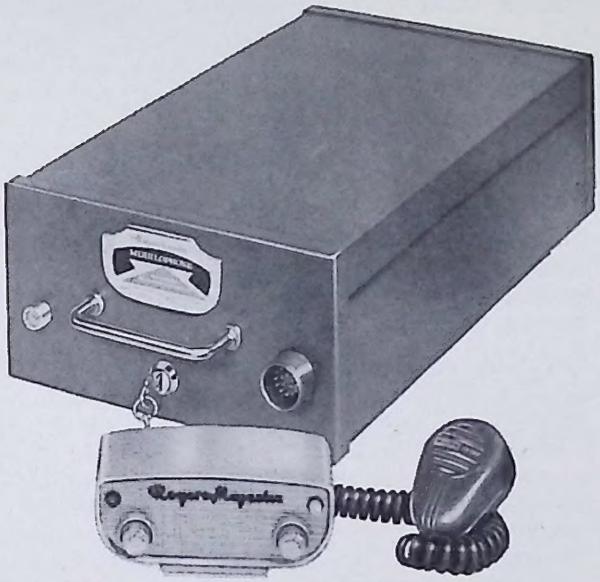


Fig. 1

General Description

The models RM539 and RM541 include a crystal-controlled FM transceiver and a completely transistorized power supply for operation from 12 volts. In the illustration shown in Figure 2 the transformer unit is mounted in the trunk but, through the cable and control unit provided, it can be completely controlled from the cab of any vehicle.

Both models have a power output of 30 watts and cover a frequency range from 148 to 174 mc; however the RM539 has a channel spacing of 30 kc whereas in the RM541 it is 60 kc.

The crystal-controlled FM receiver incorporates 13 tubes and 22 tuned circuits while the transmitter uses 9 tubes and 12 tuned circuits.

A serious problem in the design of such receivers is the susceptibility to ignition interference and this has been minimized by the use of a lumped i-f filter having a linear phase characteristic across the band pass; also by the use of a gated-beam limited discriminator circuit having a very short time constant.

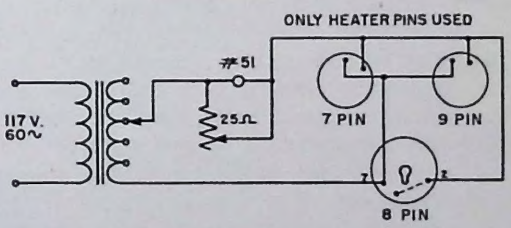
for technicians

Potpourri – An old insect sprayer makes a good blower for removing dust from inaccessible locations in a chassis. Remove the piston, clean and lubricate the barrel. . . . A typewriter-ribbon spool wound with solder makes a very handy dispenser. It will hold the solder upright for tinning wires etc. . . . Plastic insulation from #14 wire makes a good flexible spout for oiling hard-to-get-at spots. This tubing is easily forced over the short spout of an oil can.

JOHN A. DEWAR, Belleville, Ont.

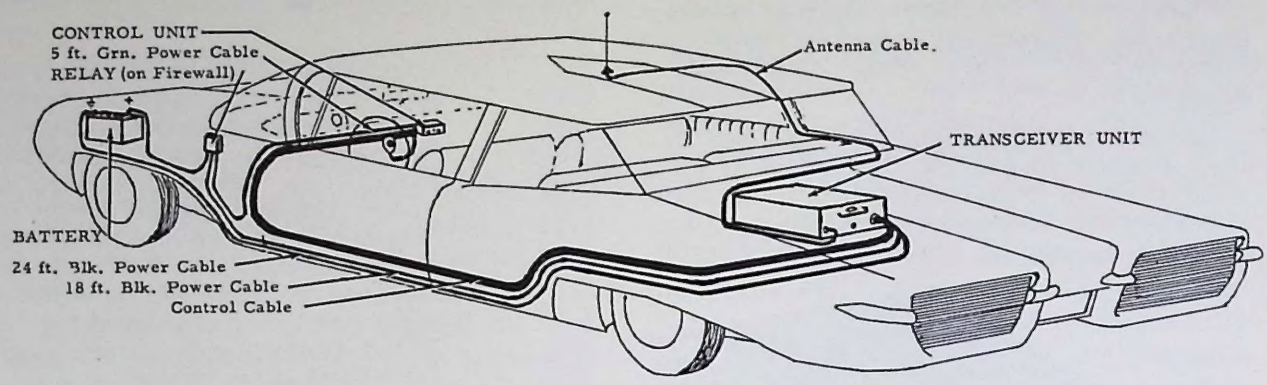
★ ★ ★

Tube Tester – Testing tubes for series-string heaters in TV sets can sometimes be confusing. For example, when testing cold tubes, a closed heater circuit may be indicated. However, as the heater warms up, the circuit will break. A simple device is required to increase the heater voltage gradually and an indicator to show when the break occurs. The device illustrated herewith was assembled using an old filament transformer and selector switch from a tube tester. (The manufacturer had provided a new transformer and roll charts to bring the tube tester up to date.) The



25-ohm rheostat across the pilot lamp allows adjustment for various values of heater current. The sockets used were 7, 8 or 9 pin octal. The tests should start on the lowest voltage tap, then switching for successively higher voltages and adjusting the rheostat so that the pilot light is at half brilliancy. When the heater break occurs, the light will go out. If a transformer of this type is not available, a suitable transformer may be purchased but be sure to see that the switch is of the non-shorting type.

J. M. WALLACE, Toronto, Ontario.



The Receiver Circuit

A study of the circuit diagram will show that, while the receiver employs 13 tubes, three are dual-purpose so that the effective number of tubes is 16.

The receiver is a superheterodyne of the dual-conversion type with intermediate frequencies of 8 mc and 455 kc. Two r-f stages operating at the signal frequency are followed by a triode first mixer. There is a ferrite bead on the plate lead of the mixer and this serves to remove the vhf signal from the mixer plate circuit and so ensures stable mixer operation.

The signal is injected into the first mixer by way of a pentode crystal oscillator and a pentode multiplier. Either of the available two channels may be selected by connecting in the appropriate crystal by means of a relay, the unused crystal being shorted out. Each crystal has its own vernier capacitor which permits precise adjustment of the oscillator to the required channel frequency. The bandwidth of the 5 tuned circuits between antenna and first mixer grid is such that performance deterioration is negligible when the channels are spaced not more than 500 kc apart.

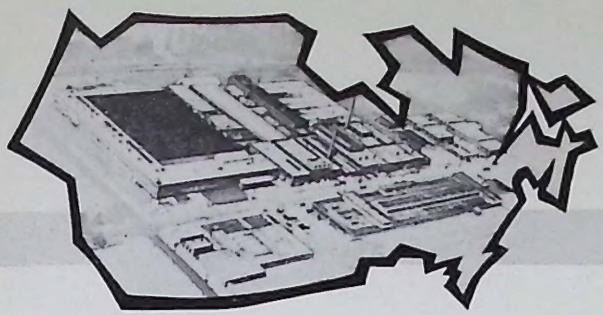
A single stage 8 mc i-f amplifier has 6 tuned circuits in 3 inductively-coupled pairs and the second mixer is fed from a triode oscillator operating at 8455 kc. The output of this second mixer feeds into a 455 kc lumped i-f filter which has 8 tuned circuits with ferrite cores. This filter is permanently adjusted and is well sealed against humidity. It is the main element in the circuit as far as fixing the bandwidth characteristics is concerned. Provision is made so that filters can be readily interchanged in the field if it should become desirable to modify the bandwidth or selectivity characteristics. For example, a change might be made from 60 kc channel spacing to 30 kc.

A high-gain three-stage second i-f amplifier tuned to 455 kc feeds into a gated-beam limiter-discriminator and the output of the latter drives a two-stage audio amplifier. An a-f output of at least 2 watts at less than 8% distortion is obtained for modulation swings of plus or minus 3.5 kc at 1000 cycles.

The Squelch Circuit

This is composed of a cascade-triode noise amplifier and a diode noise rectifier. The output of the latter puts the audio tubes out of commission by applying a cut-off bias to their control grids in the absence of an incoming carrier. After the threshold control is set so that the audio is just silenced at zero signal input and a signal is applied with standard test modulation, continuous a-f output will be obtained at signal inputs of 0.2 microvolts or less. This means that, if the squelch control is set so as to just silence the set noise, the squelch will open at signal levels less than the signal strength required for intelligible communication.

The foregoing roughly outlines the circuitry of the receiver portion of the unit. In our next issue we will consider the transmitter portion so the reader should keep the insert circuit diagram readily available because it will be needed again. We will also cover the power unit and provide some hints on servicing.



industry news

Color TV Revival – It is interesting to note that U.S. manufacturers who dropped out of the color TV field a year or so ago are now returning to the fold. To these can be added the name of the Organ Corp. of America who, having bought out the assets of Willoughby Electronics, will begin the production of color sets in June. This bedfellow is not so strange as first appears because there is a TV background. The vice-president of Organ was formerly the president of Viewtone who marketed a $100 7-inch TV receiver – prior to World War II!

That Long Pause – For Commercials – When asked about the chances of CBC recruiting some of its senior executives from big American networks, president J. A. Ouimet replied that he thought the CBC had gone a shade too far in its commercial broadcasting. He remarked further that American network personnel take a purely commercial approach to programming while at CBC "our first objective is public service."

Multiplex Stereo Approved – FM set manufacturers and the broadcasting industry expressed satisfaction (a feeling expressed in Canada too) with the FCC action authorizing multiplex stereophonic broadcasting on a regular basis effective June 1. The authorized system is FM/AM, with the subcarrier using AM modulation. It uses suppressed-carrier double-sideband technique and is fully compatible with straight FM broadcasting. However, leaders in the field see some time-lag while certain problems and bugs are ironed out.

Beaver Awards – Three radio and two TV stations have been chosen by a board of judges to win the Beaver Awards for distinguished service to Canadian broadcasting. They are CKWX-Radio, Vancouver, and CHCH-TV, Hamilton, CKRC-Radio, Winnipeg, CJON-Radio, St. John's and CKCK-TV, Regina.

BBG Approvals and Denials – Licenses for new CBC TV stations at Flin Flon, Man., and Cranbrook, B.C., were recommended. A bid for a TV station at Ste. Anne des Monts, Que., was denied. Satellite stations approved were: Carrot Creek, Alta., (outlet for CFRN-TV, Edmonton), Edson, Alta., (to be fed from Carrot Creek), Stranrear, Sask., (an outlet for CFQC-TV, Saskatoon), The Pas, Man., (outlet for the new Flin Flon station). Application for a satellite at Kindersley, Sask., was denied.

RADIO NETWORK STATIONS

CBC Trans-Canada Network

Atlantic Region (Basic)

CBI	Sydney
CBH	Halifax
CFNB	Fredericton
CBA	Sackville
CHSJ	Saint John

Atlantic Region (Supp.)

CBN	St. John's
CBY	Cornerbrook
CBG	Gander
CBT	Grand Falls
CKBC	Bathurst
CKBW	Bridgewater
CKEC	New Glasgow
CFGB	Goose Bay
CKMR	Newcastle

Mid-Eastern Region (Basic)

CBM	Montreal
CBO	Ottawa
CKWS	Kingston
CBL	Toronto
CBE	Windsor
CKSO	Sudbury
CFCH	North Bay
CJKL	Kirkland Lake
CKGB	Timmins
CJIC	Sault Ste. Marie
CKPR	Fort William

Mid-Eastern Region (Supp.)

CHOK	Sarnia
CJQC	Quebec
CKOC	Hamilton
CHLO	St. Thomas
CJNR	Blind River

Prairie Region (Basic)

CBW	Winnipeg
CBK	Watrous
CBX	Edmonton
CBXA	Edmonton
CJOC	Lethbridge

Prairie Region (Supplementary)

CKCK	Regina
CFAR	Flin Flon
CFGP	Grande Prairie
CJCA	Edmonton
CFAC	Calgary
CJDC	Dawson Creek
CHFC	Fort Churchill

Pacific Region (Basic)

CFJC	Kamloops
CKOV	Kelowna
CJAT	Trail
CBU	Vancouver
CFPR	Prince Rupert

Pacific Region (Supplementary)

CKLN	Nelson
CKPG	Prince George
CFYT	Dawson
CFWH	Whitehorse
CFYK	Yellowknife
CBXH	Fort Smith
CFHR	Hay River

CBC Dominion Network

Atlantic Region (Basic)

CJCB	Sydney
CJFX	Antigonish
CFCY	Charlottetown
CHNS	Halifax
CKCW	Moncton
CKNB	Campbellton
CJLS	Yarmouth
CFBC	Saint John

Mid-Eastern Region (Basic)

CKTS	Sherbrooke
CFCF	Montreal
CKOY	Ottawa
CHOV	Pembroke
CFJR	Brockville
CJBC	Toronto
CHEX	Peterborough
CFPL	London
CFCO	Chatham
CFPA	Port Arthur
CJRL	Kenora

Mid-Eastern Region (Supplementary)

CKCV	Quebec
CKTB	St. Catharines
CHML	Hamilton
CKPC	Brantford
CKCR	Kitchener
CKNX	Wingham
CJCS	Stratford
CFOS	Owen Sound
CJSS	Cornwall
CJBQ	Belleville
CFOR	Orillia
CFOB	Fort Francis
CHNO	Sudbury
CKLW	Windsor
CKLC	Kingston

Prairie Region (Basic)

CKRC	Winnipeg
CJGX	Yorkton
CKX	Brandon
CKRM	Regina
CHAB	Moose Jaw
CFQC	Saskatoon
CKBI	Prince Albert
CFCN	Calgary
CFRN	Edmonton

Prairie Region (Supplementary)

CHAT	Medicine Hat
CKRD	Red Deer

Pacific Region (Basic)

CHWK	Chilliwack
CJOR	Vancouver
CJVI	Victoria

Pacific Region (Supplementary)

CJIB	Vernon
CKOK	Penticton

CBC French Network

(Basic)

CBF	Montreal
CBV	Quebec
CBJ	Chicoutimi
CBAF	Moncton
CHNC	New Carlisle

(Supplementary)

CKCH	Hull
CHGB	Ste. Anne de la Pocatière
CJBR	Rimouski
CKRN	Rouyn
CKVD	Val d'Or
CHAD	Amos
CKLS	La Sarre
CHLT	Sherbrooke
CJEM	Edmundston
CJFP	Rivière du Loup
CKLD	Thetford Mines
CKVM	Ville Marie
CKBL	Matane
CFBR	Sudbury
CFCL	Timmins
CKSB	St. Boniface
CFNS	Saskatoon
CFRG	Gravelbourg
CHFA	Edmonton
CKRB	St. Georges de Beauce

what's NEW?

in semi-conductors, tubes and components

How not to treat a Transistor

Today, the servicing of transistorized equipment represents a large share of the average technician's business. We feel it would, therefore, be useful to list the "**do not**" points for working with the transistor.

As you know, tubes can easily bear a reasonable overload. If the tube is operated with a higher plate voltage than indicated, it will probably only affect the life of the tube.

This is not so for a transistor. If too large a collector voltage is applied, it will normally break down. We have, therefore, collected the experience we have gained with transistors, which can be summarized in the 13 things you must not do:

1. **DO NOT** short the leads, especially collector-base (an alligator clip may be the cause of this).
2. **DO NOT** solder in a circuit to which the battery voltage is connected.
3. **DO NOT** use too large a soldering iron without a thermal shunt. Even if the transistor is not destroyed, its properties may be changed.
4. **DO NOT** solder with a "live tip" soldering iron (an ungrounded soldering iron can short-circuit between the tip and the heater, without it being noticed). Moreover, it is advisable to use a low-voltage soldering iron with a mains transformer.
5. **DO NOT** solder with soldering "pencils" connected to the same battery as the apparatus. Small soldering pencils for low voltages normally have the tip connected to the heater coil. If you are working on a car radio, for example, it is tempting to connect a soldering iron to the accumulator which provides the current for the apparatus. But if you do this, you run the risk of having to replace the electrolytic capacitators and transistors when you are finished.
6. **DO NOT** interrupt the current in a self-inductance when a transistor is in the circuit. When the current is broken, a voltage pulse is produced which can destroy the transistor.
7. **DO NOT** use a buzzer or bell when looking for faults.
8. **DO NOT** measure with a low resistance instrument.
9. **DO NOT** measure with an ohmmeter on the lowest range. The current from the instrument may be large enough to destroy a small transistor.
10. **DO NOT** reverse the terminals of the battery.
11. **DO NOT** apply too high a voltage if you work from the mains instead of batteries.
12. **DO NOT** mount a transistor the wrong way round.
13. **DO NOT** scrape paint off a glass transistor which is painted black. Sunlight on a transistor to which voltage is applied may cause an increase in the current.

All these rules may have frightened you, but there is no need for that. Transistors are quite hardy; for example, in 99 cases out of 100, you can mount a transistor the wrong way round (collector and base reversed) without any other effect than decreasing the amplification in the circuit. But carelessness can be expensive in the long run.

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